IBM

Technical Publication

Understanding Design Automation

UNDERSTANDING DESIGN AUTOMATION

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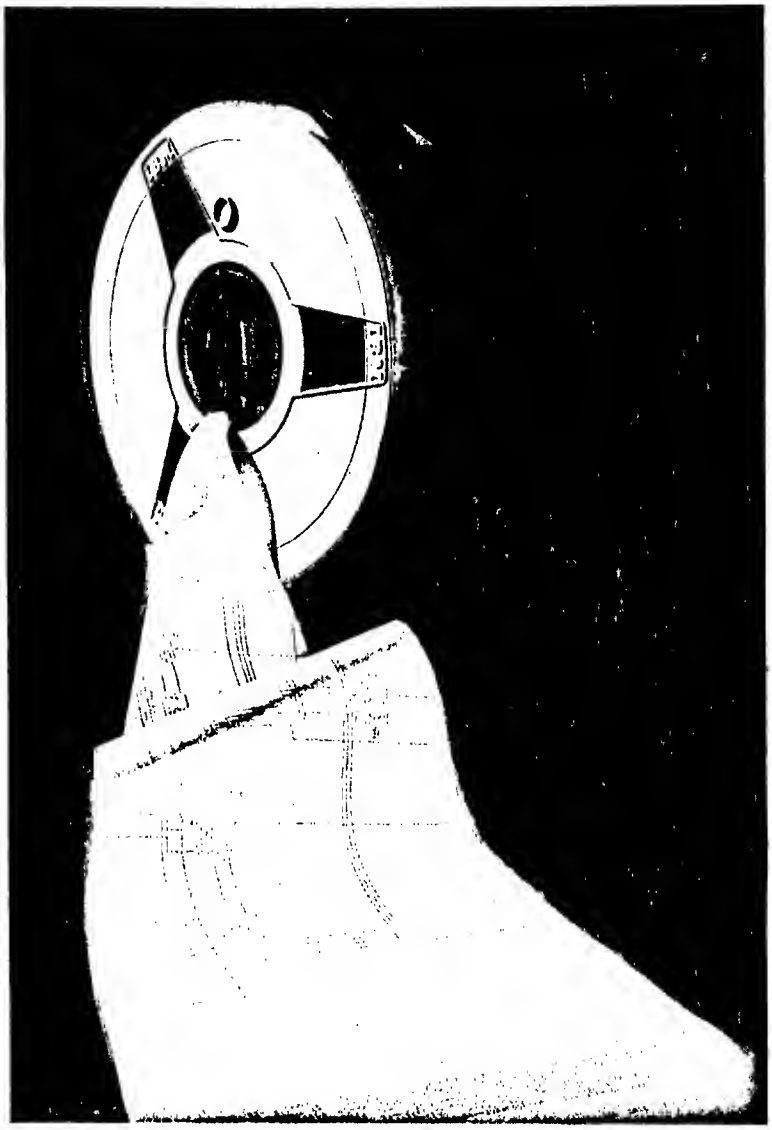

FOREWORD

The purpose of this brochure is to assist the engineer in understanding the over-all Design Automation System. The simple portrayal of the computer system with respect to inter-relations between the stages of the system and with respect to input-output documents is shown. Equally important facts such as (1) the procedure for implementing Design Automation, (2) the documents required for releasing a machine, and (3) the planning of work-loads are stated. Becoming familiar with the following pages will lead to a better comprehension of how to effectively utilize Design Automation.

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CLOSING THE DEVELOPMENT TIME GAP

Leadership in the computer field depends upon a company's ability to produce the most advanced data processing equipment. This in turn is dependent upon the utilization of advanced technologies as soon after their development as possible. The length of the time lag between the development of new circuitry and its incorporation in a new computer system, for example, can make the difference between success and failure.

Design automation is one means of closing the development time gap. It provides for the expeditious processing and updating of a machine by computer means. Computers are used for the preparation of manufacturing and customer engineering documents, the effective debugging on paper of a machine system, and the automatic routing of wire as well as the determining of wire-type on an SMS panel.

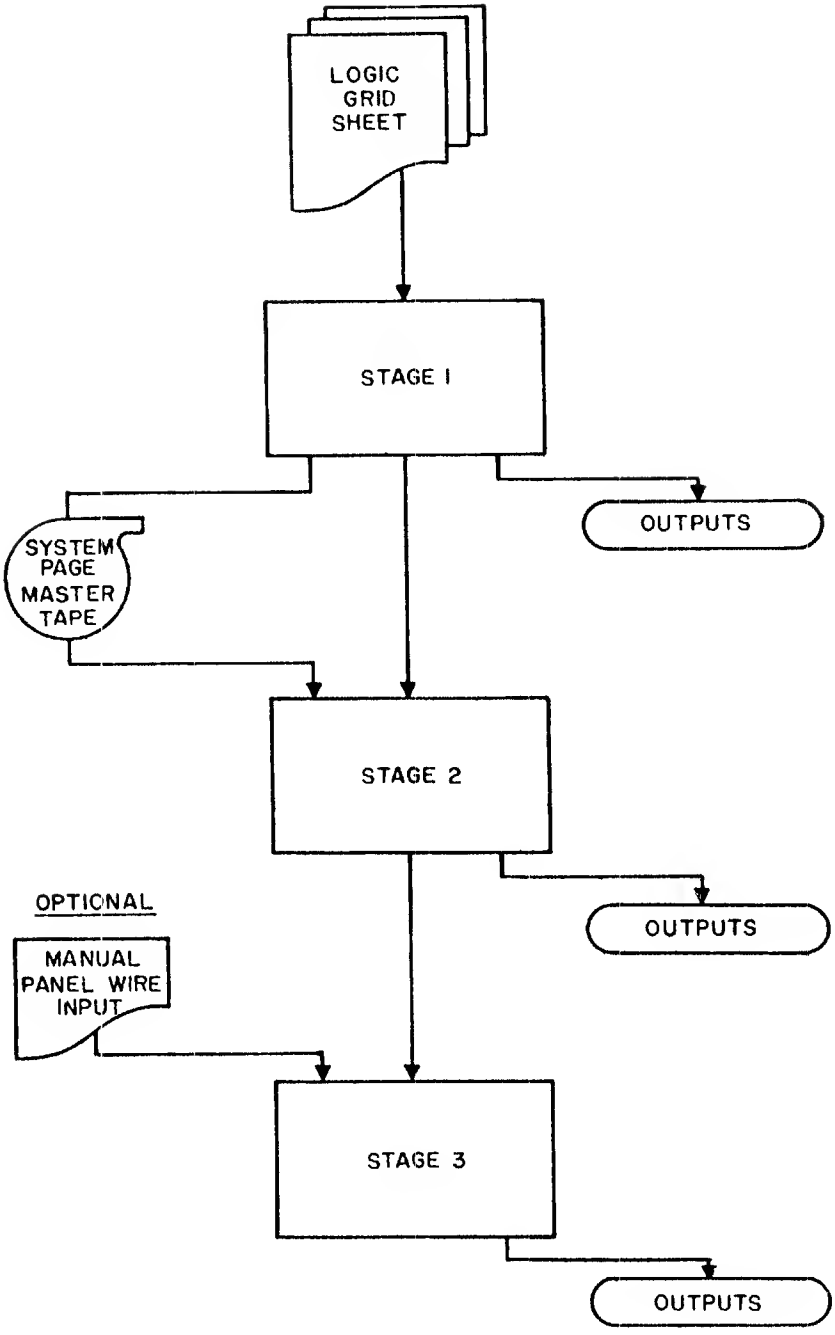
Another feature of design automation is the advantage of conformity of the logic representation. All machine systems are similar in respect to the layout of the system page. Customer engineering finds uniformity in system-page terminology helpful when educating men on two different machine systems.

Design automation is also a flexible and dynamic system. Program changes can be made to accommodate certain special requests. To obtain specific results, prespecifications that override certain computer decisions can be instituted. It is felt that the areas of machine simulation and fabrication offer the greatest promise for future progress in this program.

THE DESIGN AUTOMATION PROGRAM

There are three basic stages within the design automation program: Stage 1, Preparation of system page master tape; Stage 2, System page validity check; Stage 3, Panel wiring. Each stage is dependent on the output of a preceding stage, yet every one is run separately. Numerous computer programs make up the framework of each stage. The scope of these particular programs will not be discussed here.

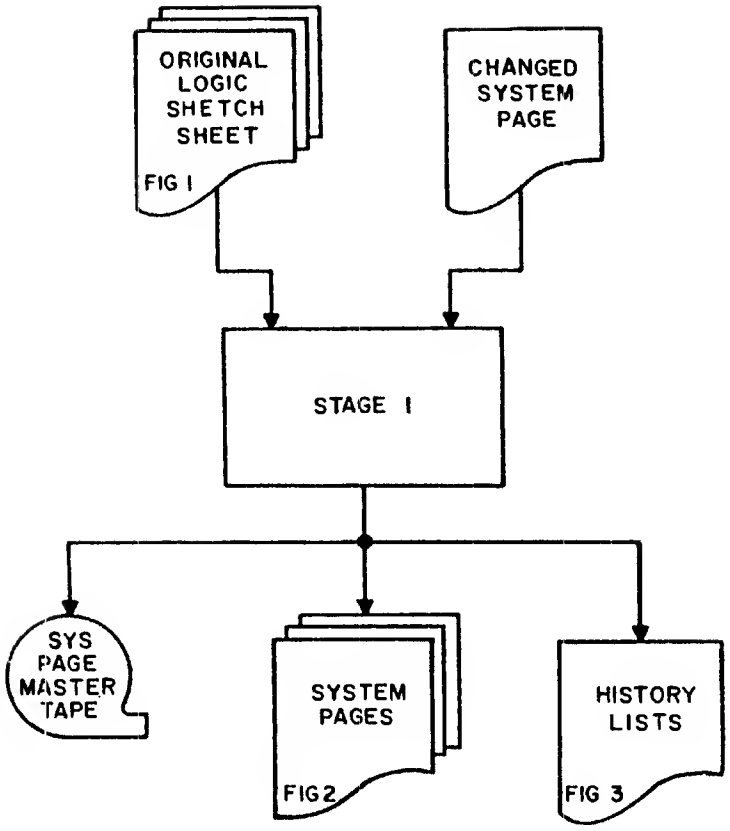
The outputs from the stages consist of documents which contribute to development of the final machine. The system page tape which is generated from Stage 1 is the master document from which subsequent stages operate, and to which all logical design changes or additions are applied. A manual panel wire input into Stage 3 is optional. Its purpose is to enable the processing of panel wiring in a uniform manner for special situations that require the first two stages to be by-passed. It is also used to enter service wiring, to enable engineering intervention, and to control unique situations while obtaining the bulk of the signal wiring automatically. A closer look at each of the three stages follows.



Three Stages of the General Program

Stage 1, Preparation of System Page Master Tape -- Original pages or changes to existing systems pages are keypunched into machine language, edited for accuracy, and merged in sequence by systems page number on the master tape. The master tape is the document from which system pages are printed and to which the checking programs are applied.

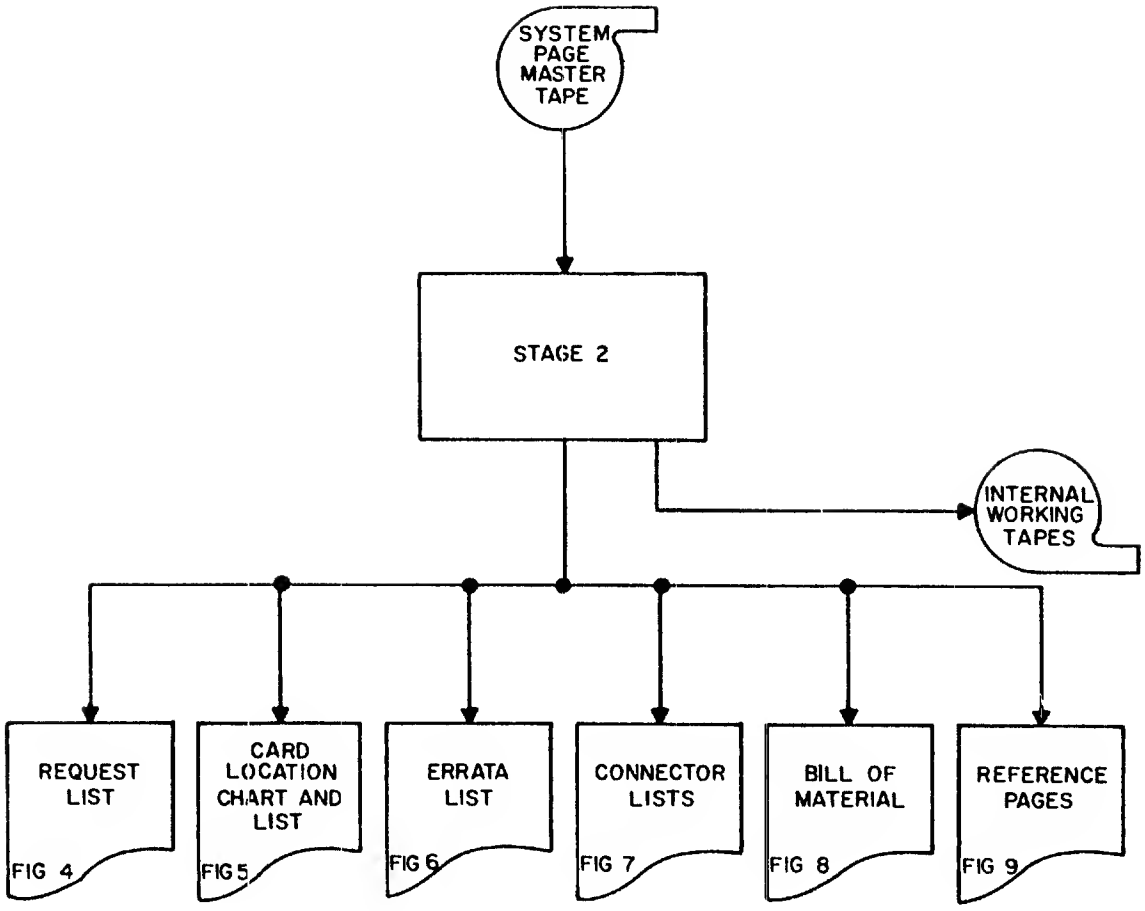
Blanket changes to systems pages on existing master tapes, such as changing machine designations, machine location on logic blocks, and system page numbering, can be accomplished by present computer programs. All released engineering levels for a released system page are retained on tape. System's printouts can be obtained for any page at any level.



Figures referred to here begin on page 10

Stage 1 - Preparation of System Page Master Tape

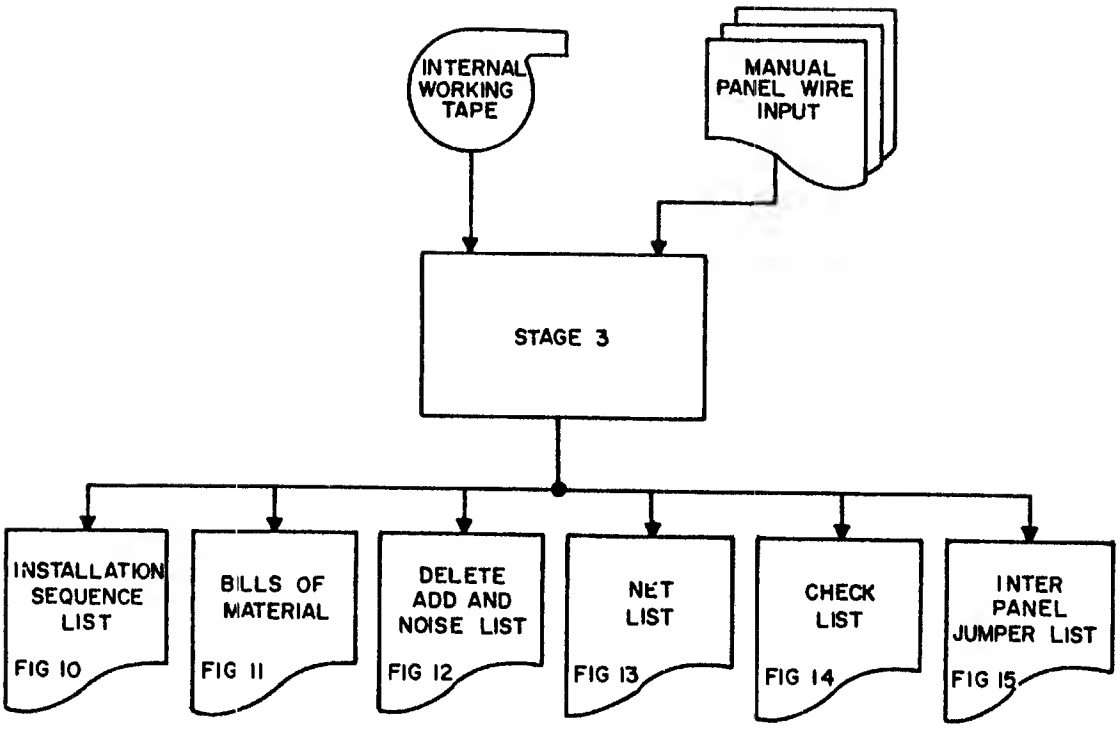
Stage 2, System Page Validity Check -- The machines systems are checked for electrical accuracy, interpage communication and package standardization. Errors are indicated, but not automatically corrected. The accumulation of data leads to direct outputs from Stage 2 as well as panel wiring outputs from Stage 3.



Figures referred to here begin on page 12

Stage 2 - System Page Validity Check

Stage 3, Panel Wiring -- Panel pin data accumulated from the systems pages or from manually produced data is automatically routed. Wire types are upgraded if the noise voltage pickup is detrimental to operation and downgraded if the length of the coaxial or twisted pair wire is impractical for installation. Add and delete instructions are produced when engineering changes are made to existing wired panels. Manual inputs to the program are only used when expedited panel wire changes are required.



Figures referred to here begin on page 17

Stage 3 - Panel Wiring

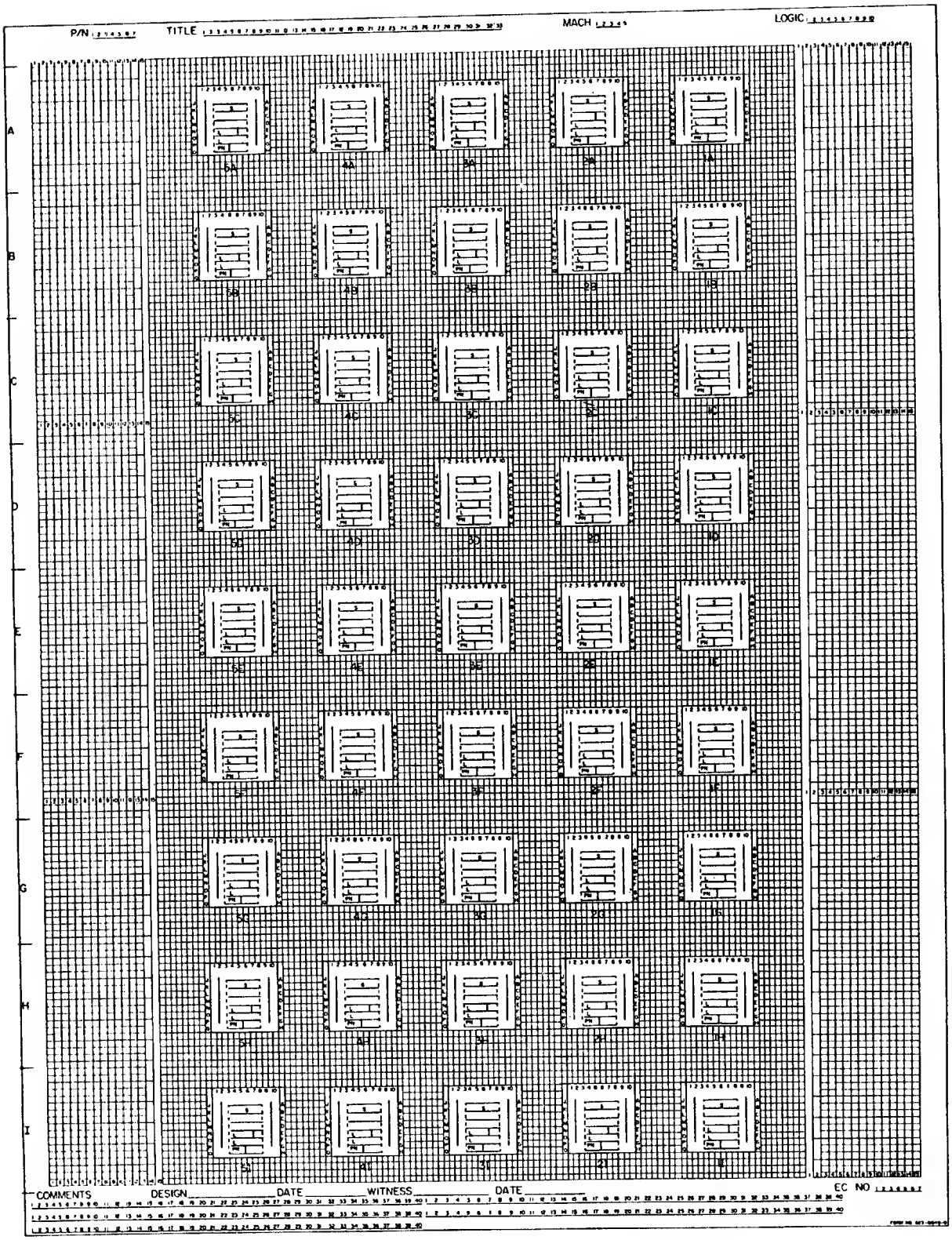


Figure 1 - Logic Sketch Sheet is the Page on which the Initial Logic of a Machine is Drawn

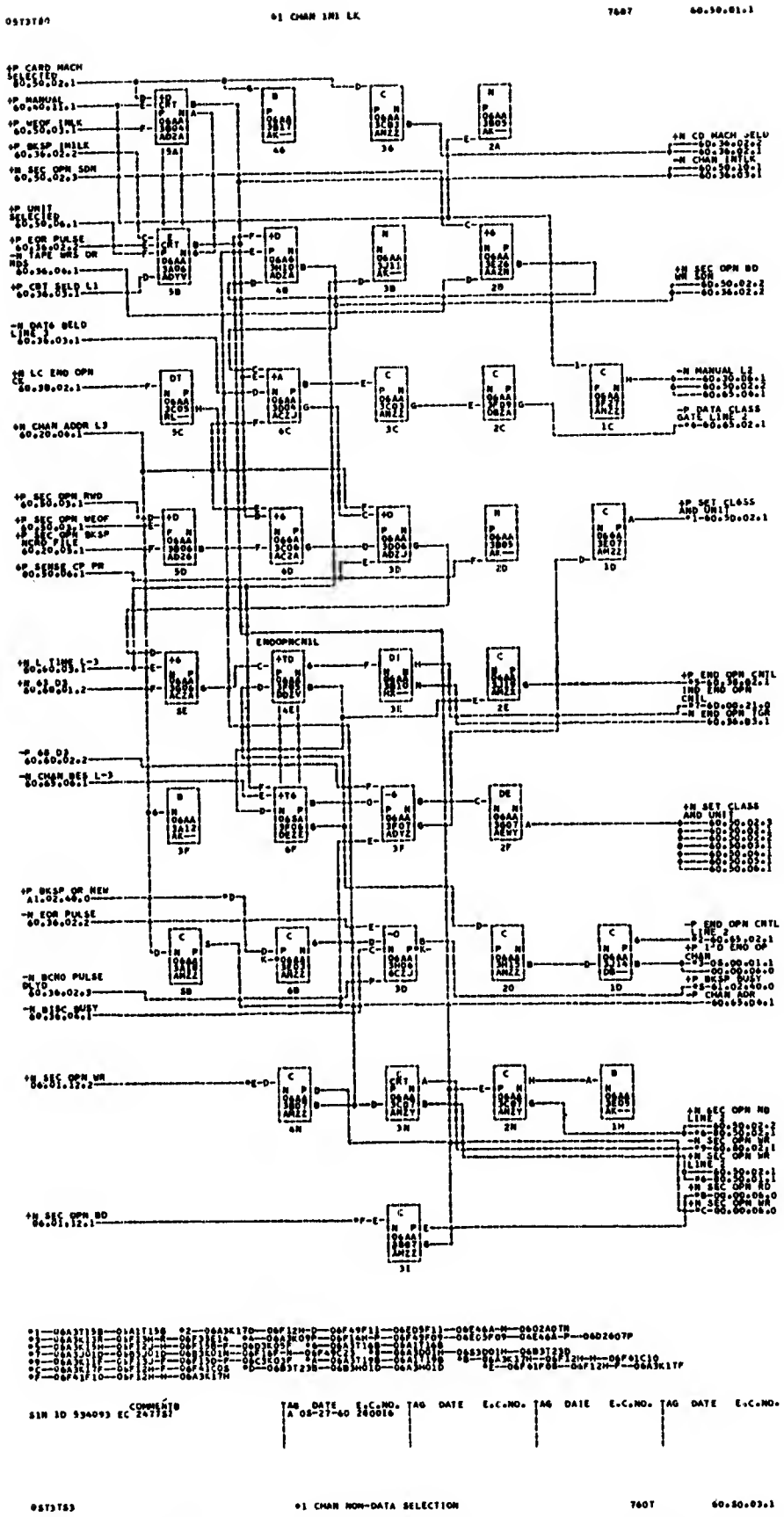


Figure 2 - Systems Pages Contain a Printout of the Pages on the Master Tape

RUN NO 113 MASTER TAPE HISTORY LISTING FOR MACH 7050 DATE0 5-18-60

PAGE	P N	TITLE	TAG	ENG.CHG	DATE
10.01.10.1		OSCILLATOR			
			A	PREC029	11-25-59
			B	PREC040	12-18-59
			C	PREC050	12-29-59
			0	PREC075	2-09-60
			E	PREC087	2-24-60
			F	PREC113	5-14-60
10.01.11.1		CLOCK RING 1ST OF 2 SHEETS			
			A	PREC029	11-25-59
			B	PREC050	12-29-59
			C	PREC087	2-24-60
			0	PREC106	4-20-60
			E	PREC113	5-14-60
10.01.12.1		CLOCK RING 2ND OF 2 SHEETS			
			A	PREC029	11-25-59
			B	PREC040	12-18-59
			C	PREC050	12-29-59
			0	PREC075	2-09-60
			E	PREC087	2-24-60
			F	PREC113	5-14-60
10.01.13.1		USE OR MANUAL STATUS CONTROL			
			A	PREC029	11-25-59
			B	PREC040	12-18-59
			C	PREC050	12-29-59
			0	PREC075	2-09-60
			E	PREC084	2-20-60
			F	PREC087	2-24-60
			G	PREC090	3-03-60
			H	PREC098	3-21-60
			1	PREC106	4-20-60
			J	PREC113	5-14-60
10.01.14.1		START MEM TRIGGER			
			A	PREC029	11-25-59
			B	PREC040	12-18-59
			C	PREC050	12-29-59
			0	PREC075	2-09-60
			E	PREC084	2-20-60
			F	PREC087	2-24-60
			G	PREC090	3-03-60
			H	PREC113	5-14-60
10.02.10.1		PULSE DISTRIBUTION GATING LINES			
			A	PREC029	11-25-59
			B	PREC040	12-18-59
			C	PREC050	12-29-59
			0	PREC075	2-09-60

Figure 3 - History List is an Index of all Pages Contained on the Master Tape

7701 REQUEST LIST

MACHINE	LOGIC NO.	PART NO.	TAG	E.C.NO.	PAGE NAME	REMARKS
7701	0107011	0555170	D	PREC004	READ CONTROL	
7701	0107012	0555171	D	PREC004	READ BUS	
7701	0107021	0555172	C	PREC004	WRITE CONTROL	
7701	0107022	0550173	C	PREC004	WRITE BUS	
7701	0107031	0550174	C	PREC004	ERROR CONTROL	
7701	0107032	0555175	C	PREC004	RECORD SUBSTITUTION	
7701	0107033	0555176	D	PREC004	1ST CHAR BACKSPACE	
7701	0107041	0550177	C	PREC004	READY AND REWIND CONTROL	
7701	0107042	0555178	D	PREC004	TAPE INDICATION	
7701	0107043	0550179	C	PREC004	DOOR CONTROL	
7701	0107051	0555180	D	PREC004	SWITCHES	
7701	0107052	0550181	B	PREC002	SWITCHES	

Figure 4 - Request List Contains the Systems Page Numbers that are Included in the Checking Run

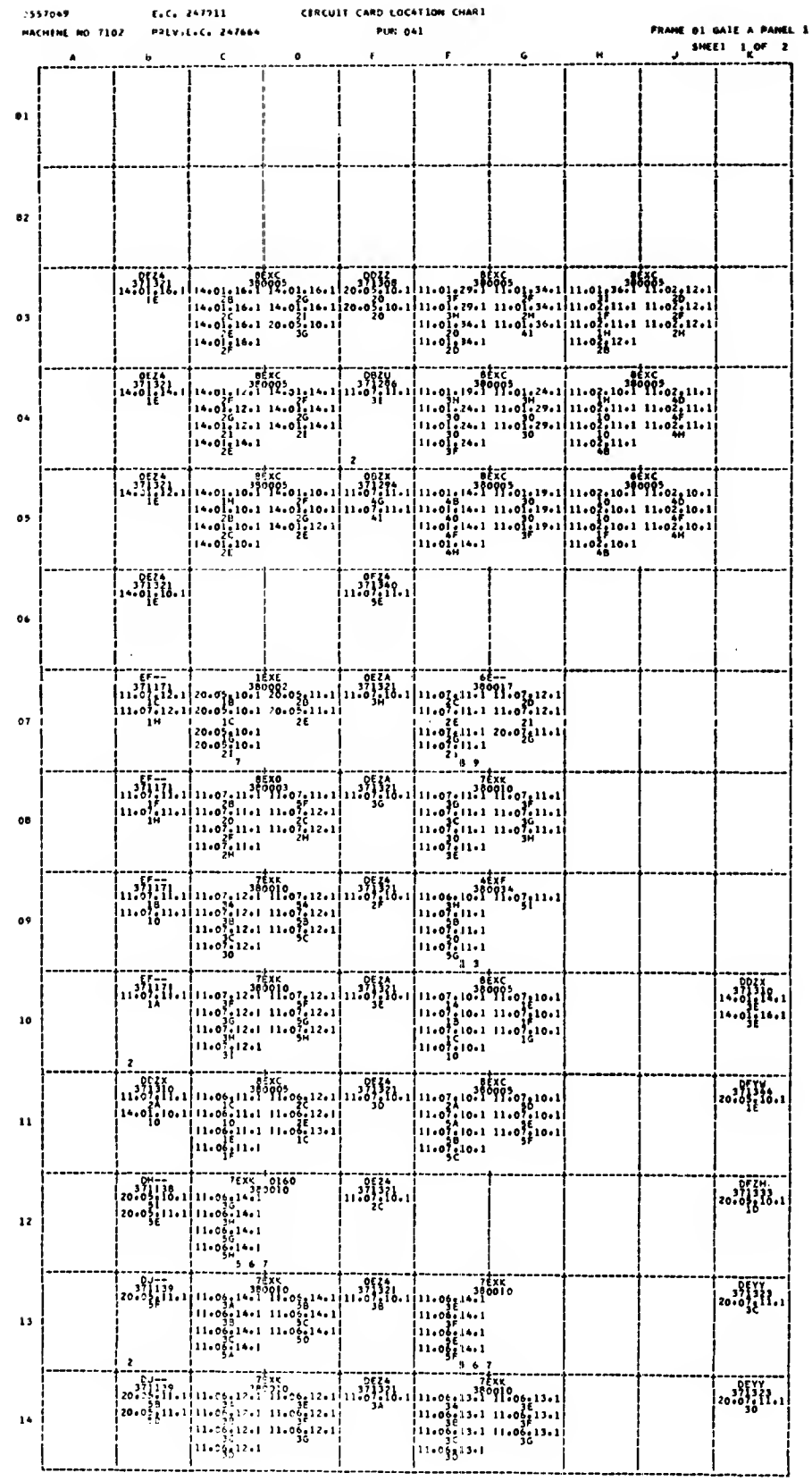


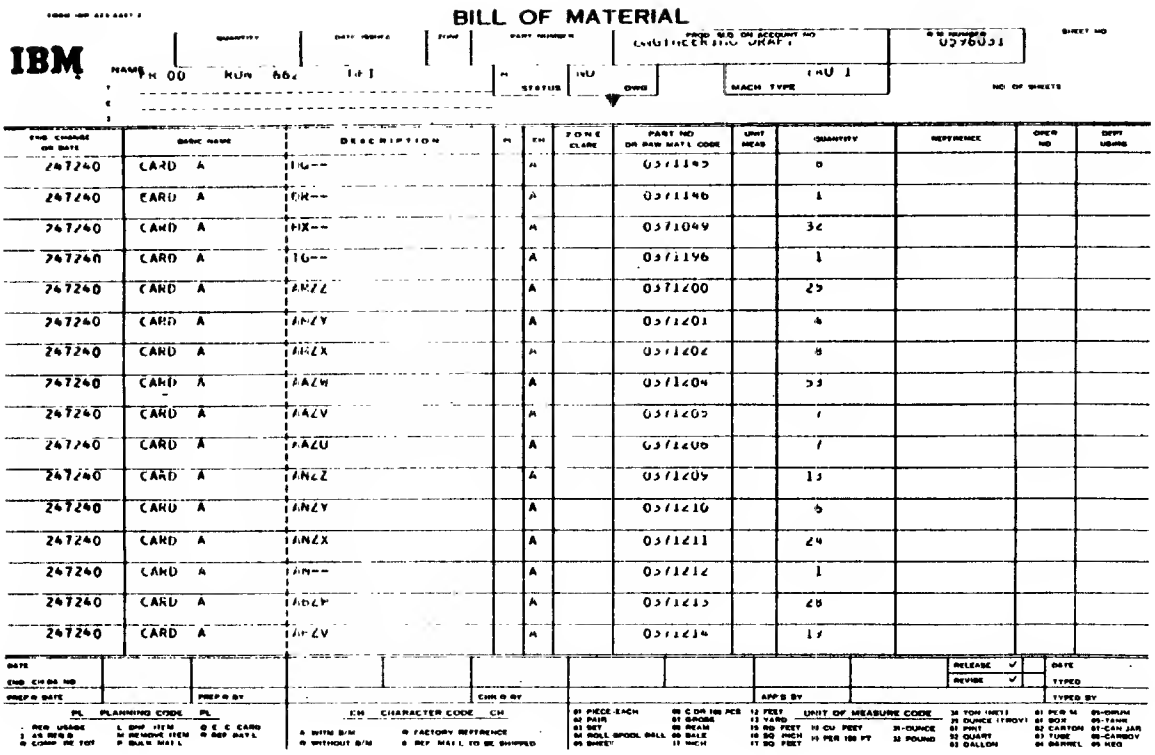
Figure 5 - Card Location Chart and List Indicates Location of Circuit Card within a Panel. Available Circuits as well as Page Designations as to where a Circuit is Logically Represented are Indicated

```
                                    AUTOMATION OF DESIGN - POUGHKEEPSIE
                                      DEVIATION FROM DESIGN STANDARDS

MACHINE * 7701                                  RUN 783                                    01.07.01.1

THE FOLLOWING CONNECTOR IS USED MORE THAN ONCE
          01B6002R   WITH BLOCK 2B AND BLOCK 1A ON PAGE 01.07.02.1                                    48
                                2B           5G         01.07.03.1
          01B6C03R              2C           2B         01.07.03.2
                                2C           4A         01.07.03.2
                                2C           5F         01.07.03.3
          01B6C01A              3C           2C         01.07.02.1
                                3C           3F         01.07.02.1
                                3C           5I         01.07.02.2
                                3C           3D         01.07.03.1
                                3C           4I         01.07.03.1
                                3C           3H         01.07.03.2
                                3C           5E         01.07.03.2
                                3C           4B         01.07.03.3
                                3C           4E         01.07.03.3
                                3C           3B         01.07.04.1
                                3C           3C         01.07.04.1
                                3C           3B         01.07.04.2
          01B60010              4A           4C         01.07.02.1
                                4A           5C         01.07.02.1
                                4A           5I         01.07.03.1
          01B6C01G   WITH BLOCK 4A AND BLOCK 5F ON PAGE 01.07.03.3
          01B6C01N              5E           3A         01.07.03.1
          01B60010              5F           5H         01.07.02.1
```

Figure 6 - Errata List Consists of the Errors Contained on Systems Pages. Errors are Indicated by Page and Classified as Electrical Deficiency, etc.

```
   PANEL     CONNECTOR LOCATION LIST  MACH  71011  MFI        PREV  EC 246915
LOCATION 13A1  PART NUMBER            E.C. 7   94  RUN  694  PAGE 003

  CONNECTOR      PAGE          BLOCK    NET      LINE NAME
   13A1B28B    27.09.03.1      4G     009553  &P SUM 12 TO MEM AREA DEC
   13A1B28C    27.09.03.1      4E     009552  &P SUM 13 TO MEM AREA DEC
   13A1B28D    27.09.02.1      4C     009527  &P SUM 18 TO MEM AREA DEC
   13A1B28F    27.09.02.1      4A     009525  &P SUM 19 TO MEM AREA DEC
   13A1B28G    27.09.01.1      4G     009506  &P SUM 20 TO MEM AREA DEC
   13A1B28H    27.09.01.1      4E     009505  &P SUM 21 TO MEM AREA DEC
   13A1B28K    27.09.01.1      4C     009504  &P SUM 22 TO MEM AREA DEC
   13A1B28L    27.09.01.1      4A     009503  &P SUM 23 TO MEM AREA DEC

   13A1C28B    27.09.06.1      4G     009621  &P SUM 00 TO MEM AREA DEC
   13A1C28C    27.09.06.1      4E     009620  &P SUM 01 TO MEM AREA DEC
   13A1C28D    27.09.06.1      4C     009619  &P SUM 02 TO MEM AREA DEC
   13A1C28F    27.09.06.1      4A     009618  &P SUM 03 TO MEM AREA DEC
   13A1C28G    27.09.05.1      4G     009597  &P SUM 04 TO MEM AREA DEC
   13A1C28H    27.09.05.1      4E     009596  &P SUM 05 TO MEM AREA DEC
   13A1C28K    27.09.05.1      4C     009595  &P SUM 06 TO MEM AREA DEC
   13A1C28L    27.09.05.1      4A     009594  &P SUM 07 TO MEM AREA DEC
   13A1C28M    27.09.04.1      4G     009575  &P SUM 08 TO MEM AREA DEC
   13A1C28P    27.09.04.1      4F     009574  &P SUM 09 TO MEM AREA DEC
   13A1C28Q    27.09.04.1      4C     009573  &P SUM 10 TO MEM AREA DEC
   13A1C28R    27.09.04.1      4A     009572  &P SUM 11 TO MEM AREA DEC

   13A1D28B    27.11.04.1      2A     009848
   13A1D28C    27.11.04.1      2C     009849
   13A1D28D    27.11.04.1      2F     009850
   13A1D28F    27.11.04.1      2G     009851
   13A1D28G    27.11.05.1      2A     009891
   13A1D28H    27.11.05.1      2C     009892
   13A1D28K    27.11.05.1      2F     009893
   13A1D28L    27.11.05.1      2G     009894
   13A1D28M    27.11.06.1      2A     009934
   13A1D28P    27.11.06.1      2C     009935
   13A1D28Q    27.11.06.1      2F     009936
   13A1D28R    27.11.06.1      2G     009937

   13A1E28B    27.14.02.1      5H     007185  -P FLD LENGTH 1 WORD
   13A1E28C    27.13.05.1      5F     006211  &N Z18 ADDER
   13A1E28D    27.13.05.1      5G     006370  &N PZ18 23 PA
   13A1E28F    27.13.05.1      5D     006794  &N Z50 ADDER DC
   13A1E28G    27.13.05.1      5F     006869  &N Z P50 55 PA
   13A1E28H    27.09.04.1      4A     009816  &N SUM 11 TO RECOMP
   13A1E28K    27.10.02.1      3C     009692  &N PARITY HALF SUMS 00 07
   13A1E28L    27.10.02.1      3C     009691  -N PARITY HALF SUMS 00 07
   13A1E28M    27.10.01.1      4G     009662
   13A1E28Q    27.09.02.1      4C     009526  -P SUM 18 RECOMP
   13A1E28R    27.11.06.1      2G     008874  &P HALF SUM 25 TO ADDER CHKR
```

Figure 7 - Connector Lists Consists of Used and Unused Connectors on SMS Panels, Cable Wiring and Tailgate Wiring.



BILL OF MATERIAL

IBM

END CHANGE OR DATE	BASIC NAME	DESCRIPTION	M	TH	ZONE CLASS	PART NO OR RAW MATL CODE	UNIT MEAS	QUANTITY	REFERENCE	OPER NO	DEPT USING
247240	CARD A	1G--		A		0371195		8			
247240	CARD A	0R--		A		0371196		1			
247240	CARD A	HX--		A		0371049		32			
247240	CARD A	1G--		A		0371196		1			
247240	CARD A	AMZZ		A		0371200		25			
247240	CARD A	AMZY		A		0371201		4			
247240	CARD A	AMZX		A		0371202		8			
247240	CARD A	AAZW		A		0371204		33			
247240	CARD A	AAZV		A		0371205		1			
247240	CARD A	AAZU		A		0371206		1			
247240	CARD A	ANZZ		A		0371209		13			
247240	CARD A	ANZY		A		0371210		5			
247240	CARD A	ANZX		A		0371211		24			
247240	CARD A	AN--		A		0371212		1			
247240	CARD A	ADZP		A		0371213		28			
247240	CARD A	AMZV		A		0371214		13			

DATE
END CHANGE NO
PREPD DATE
PREPD BY
CHKD BY
APP'D BY
RELEASE ✓
REVISE ✓
DATE
TYPED
TYPED BY

PL PLANNING CODE PL

CH CHARACTER CODE CH

UNIT OF MEASURE CODE

Figure 8 - Bill of Materials List the Circuit Cards that are Used within the Machine.

P.N. 546221

FROM 7090

REFERENCE PAGE

INPUTS TO CONTROL UNIT

A1.02.30.0

TO TAU 1

PAGE	NAME	NAME	PAGE
60.40.17.1	P MANUAL WRITE DISC	&P MANUAL WRITEDISC	A1.30.11.1
60.36.04.1	-N WC & DISC	-N MANUAL OP	A1.30.11.1
60.25.20.1	&N 1 DATA LINE	&N 1 DATA LINE	A1.40.40.1
60.34.03.1	&N 2 DATA LINE	&N 2 DATA LINE	A1.40.40.1
60.25.18.1	&N 4 DATA LINE	&N 4 DATA LINE	A1.40.40.1
60.34.03.1	&N 8 DATA LINE	&N 8 DATA LINE	A1.40.40.1
60.34.02.1	&N A DATA LINE	&N A DATA LINE	A1.40.40.1
60.34.02.1	&N B DATA LINE	&N B DATA LINE	A1.40.40.1
60.34.02.1	&N C DATA LINE	&N C DATA LINE	A1.40.40.1
60.34.03.1	&P 1 MANUAL	&P 1 MANUAL	A1.40.50.1
60.34.03.1	&P 2 MANUAL	&P 2 MANUAL	A1.40.50.1
60.34.03.1	&P 4 MANUAL	&P 4 MANUAL	A1.40.50.1
60.34.03.1	&P 8 MANUAL	&P 8 MANUAL	A1.40.50.1
60.36.03.1	&P COMPARE CHK	&P COMPARE CHK	A1.50.10.1
60.34.03.1	&P A MANUAL	&P A MANUAL	A1.40.50.1
60.34.03.1	&P REQ B ONLY	&P REQ B ONLY	A1.50.10.1
60.34.03.1	&P B MANUAL	&P B MANUAL	A1.40.50.1
60.34.03.1	&P REQ A ONLY	&P REQ A ONLY	A1.50.10.1
60.34.03.1	&P C MANUAL	&P C MANUAL	A1.40.50.1
60.34.03.1	&P AMP BIAS	&P AMP BIAS	A1.40.10.1
60.35.05.1	&P ERROR TGR RESET	&P MANUAL ERRORRESET	A1.50.50.1
60.36.05.1	-N WR ECHO	-N WR ECHO	A1.50.50.1
60.36.05.1	&P SEL & RDY MIV	&P SEL & RDY MIV	A1.60.01.1
60.36.05.1	&P SEL & RDY M II	&P SEL & ROY M II	A1.60.01.1
60.40.17.1	-P MANUAL STOP ON ERROR	-P MANUAL STOP ON ERROR	A1.60.10.1
60.50.02.2	&P ODD REQ CALL	&P OOO REQ CALL	A1.40.60.1
60.50.02.2	&P EVEN REQ CALL	&P EVEN REO CALL	A1.40.60.1
60.50.02.2	&P READ CALL	&P REAO CALL	A1.60.20.1
60.50.02.1	&P WRITE CALL	&P WRITE CALL	A1.60.30.1
60.50.07.1	&P W TM CALL	&P W TM CALL	A1.60.31.1
60.50.07.1	&P WEOF CALL	&P ERASE CALL	A1.60.31.1
60.50.03.1	&P BKSP CALL	&P BKSP CALL	A1.60.40.1
60.36.03.1	&P DISC CALL	&P DISC CALL &P MANUAL WRITEOISC	A1.60.50.1 A1.60.50.1
60.50.07.1	&P REWIND CALL	&P REWINO CALL	A1.60.50.1
60.50.02.2	&P REW UNLOAD CALL	&P REW UNLOAO CALL	A1.60.50.1
60.40.17.1	&N TURN OFF T I	&N TURN OFF TI	A1.60.60.1
60.40.17.1	-P TURN ON T I	-P TURN ON TI	A1.60.60.1
60.50.02.2	&N SET HI DENSITY	&N SET HI OENSITY	A1.60.60.1
60.50.02.2	-P SET LO DENSITY	-P SET LO OENSITY	A1.60.60.1
60.36.04.1	&P CNTL DISC	&P MACHINE OR PWR ON RESET	A1.70.01.1
60.36.05.1	&P SEL RDY & WR	&P SEL RDY & WR	A1.60.10.1
60.36.05.1	&P SEL RDY & RD	&P SEL RDY & RD	A1.60.10.1
60.24.03.1	&N EARLY SAMPLE	&N EARLY SAMPLE	A1.10.30.1 A1.50.10.1
60.24.35.1	THERMAL INTERLOCK	THERMAL INTERLOCK	A1.70.01.1

Figure 9 - Reference Pages Consist of Items such as Intermachine Communication Lists or System Pages from which Indicator Lights are Actuated.

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SMS CHASSIS WIRE LIST

TYPE OF LIST	TYPE OF CHASSIS	MACHINE TYPE	FRAME	GATE OR MODULE	CHASSIS	RELEASED FOR ASM	SYM	E.C. NO.	DATE	VERSION OR RFI	SHEET NO.	LIST NO.
INSTALL. SEQ. SECT.C						PRESENT		248041	- -		37	0557151
07-20-60	SLG	7102	01	A	1	PREVIOUS		247911		SUB0001		0557151

SIGNAL													TWISTED PAIR OR COAX										ENG DATA			
					FROM			BODY			TO		FROM				TO									
SIGNAL DIRECT	WIRE TYPE	NET NUMBER	WIRE NO IN NET	TOTAL WIRE LENGTH	SLOT	PIN LOCATION	TERMINATOR VIA PIN LOCATION	VIA PIN LOCATION	VIA PIN LOCATION	TERMINATOR VIA PIN LOCATION	LEVEL	PIN LOCATION	SIGNAL LENGTH	REFERENCE LENGTH	REFERENCE LEVEL	REF PIN LOCATION	SIGNAL LENGTH	REFERENCE LENGTH	REFERENCE LEVEL	REF PIN LOCATION					
H	T	003379		12 1	2	C100			F100		1	F10F		2 3		C10J		2 0		F10J					
H	T	011023		12 5	2	F16F					1	J16M		2 0		F17J		2 0		J16J		1		T	
H	T	003383		12 7	2	D10C					1	G10M		2 3		D10J		2 0		G11J		1		T	
H	T	003389		15 5	2	C10A		C100	C11G		1	D11F		2 0		C10*		2 0		G11J		1		T	
H	T	003157		16 0	2	C23A			D09F		1	F09A		2 0		C23*		2 5		F09J		1		T	
H	T	001530		17 3	2	B03E					1	G03E		3 3		C03*		3 1		G09>		1		T	
H	T	001528		18 4	2	G03A			K28=		1	K28H		2 0		H03>		2 0		K28E		1	T	T	
H	T	010985		20 7	2	B15B		B16N	C17C		1	H18C		3 7		C15>		2 3		H18J		1		T	
H	T	010986		20 7	2	B15M		D16C	D18J		1	H18M		3 0		C15>		1 7		H18J		1		T	
H	T	005730		22 5	2	D04L		G04K	J19>		1	J20Q		3 3		D03>		2 0		K20*		1		T	
H	T	001524		23 1	2	B05E		H04M	H03M		1	J03E		3 3		C05*		2 5		J03*		1		T	
H	T	011036		23 5	2	B14B		D15J	D17R		1	J18A		3 7		C14>		2 0		J18*		1		T	
H	T	011037		23 5	2	B14M		C15Q	D18A		1	J18F		3 0		C14>		2 5		J18>		1		T	
H	T	010984		24 1	2	B16M		E17E	E1*			1190						2 *						T	
H				24 5																					

Figure 10 - Installation Sequence List Indicates Sequence in which a Panel should be Wired.

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SMS CHASSIS WIRE LIST

TYPE OF LIST	TYPE OF CHASSIS	MACHINE TYPE	FRAME	GATE OR MODULE	CHASSIS	RELEASED FOR ASM	SYM	E.C. NO.	DATE	VERSION OR RFI	SHEET NO.	LIST NO.
INSTALL. SEQ. SECT.C						PRESENT		248041	- -		40	0557151
07-20-60	SLG	7102	01	A	1	PREVIOUS		247911		SUB0001		0557151

SIGNAL													TWISTED PAIR OR COAX										ENG. DATA			
					FROM			BODY			TO		FROM				TO									
SIGNAL DIRECT	WIRE TYPE	NET NUMBER	WIRE NO IN NET	TOTAL WIRE LENGTH	SLOT	PIN LOCATION	TERMINATOR VIA PIN LOCATION	VIA PIN LOCATION	VIA PIN LOCATION	TERMINATOR VIA PIN LOCATION	LEVEL	PIN LOCATION	SIGNAL LENGTH	REFERENCE LENGTH	REFERENCE LEVEL	REF PIN LOCATION	SIGNAL LENGTH	REFERENCE LENGTH	REFERENCE LEVEL	REF PIN LOCATION					
						BILL OF MATERIAL																			
				T	1	S	NUMBER OF WIRES			LENGTH IN INCHES															
				V	A			070				03.7													
				V	A			026				03.9													
				V	A			045				04.0													
				V	A			022				04.1													
				V	A			009				04.3													
				V	A			011				04.4													
				V	A			018				04.5													
				V	A			010				04.6													
				V	A			005				04.7													
				V	A			012				04.9													
				V	A			006				05.0													
				V	A			006				05.1													
				V	A			005				05.3													
				V	A			008				05.4													
				V	A			002				05.5													
				V	A			005				05.6													
				V	A			006				05.7													
				V	A			007				05.9													
				V	A			009				06.0													
				V	A			019				06.1													
				V	A			004				06.3													
				V	A			004				06.4													
				V	A			007				06.5													
				V	A			007				06.6													
				V	A			012																	
				V	A			006																	

Figure 11 - Bill of Material List all Wires on Panel by Length, Quantity and Type.

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SMS CHASSIS WIRE LIST

TYPE OF LIST	TYPE OF CHASSIS	MACHINE TYPE	FRAME	GATE OR MODULE	CHASSIS	RELEASED FOR ASM	SYM	E C NO	RATE	VERSION OR REV	SHEET NO	LIST NO
AUTOMATED NOISE SECT.F						PRESENT		248041	- -		3	0557152
07-19-60		7102	01	A	2	PREVIOUS		247911		SUB0001		0557152

					SIGNAL								TWISTED PAIR OR COAX								ENG DATA
					FROM		ROUT			TO			FROM				TO				
SHEET	WIRE TYPE	NET NUMBER	WIRE NO IN NET	TOTAL WIRE LENGTH	PIN LOCATION	TERMINATOR VIA PIN LOCATION	VIA PIN LOCATION	VIA PIN LOCATION	TERMINATOR VIA PIN LOCATION	LEVEL	PIN LOCATION	SIGNAL LENGTH	REFERENCE LENGTH	REFERENCE LEVEL	REF PIN LOCATION	SIGNAL LENGTH	REFERENCE LENGTH	REFERENCE LEVEL	REF PIN LOCATION		
	V	000771		5 6	F10G		F10B			1	F13G									58.7	
	T	000771		7 9	H01P		H02L			1	J09C									8.3	T
	T	000771		11 4	J09C			J09/		2	F10G									46.9	T
	T	000771		12 1	F13G					2	C13D									59.8	T
	V	000772		5 4	F10E		F10H			1	F13E									17.5	
	V	000772		6 1	K09A					1	J09B									43.7	
	C	000772		8 6	H01Q			J09G		1	J09B										C
	T	000772		9 1	F13E					2	0130									45.7	T
	V	000772		14 1	K09A			K09)		2	F10E									155.6	V
	V	000789		5 4	009G			011B		1	D12E										
	V	000789		5 9	003E			005/		1	D06G									22.5	
	V	000789		5 6	006G		006B			2	009G									33.7	
	7	000789		7 9	E01R		E02G	E020		1	D03E									35.0	
	V	000789		13	012E		F12K	G15C		2	G16G									143.9	T
	V	000792		5 4	C09B			C11)		2	C12C									154.4	V
	V	000792		5 6	C06B			C09*		1	C09B									13.1	
	T	000792		7 5	E01M		002M	003J		1	D03F									13.1	
	T	000792		7 5	003F			006=		2	C06B									32.2	T
	V	000792		7 9	C12C		C12F	C15P		1	016G									14.4	T
																				77.5	
	V	000815		4 3	G22R					1	G22K										
	T	000815		7 5	G22R			G28E		2	G28M									28.1	
	V	000815		11 9	G22K			G23G		2	023K									5.4	T
																				268.7	V
	V	000822		1	F22H			F26/		1	F27A										
					016F			F22E		1	F22H									8.7	
								'26M		1										101.9	

Figure 12 - Delete-Add and Noise Lists Contain Changes that must be Applied to Existing Panel Plus Wires that have Excessive Noise Pickup.

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SMS CHASSIS WIRE LIST

TYPE OF LIST	TYPE OF CHASSIS	MACHINE TYPE	FRAME	GATE OR MODULE	CHASSIS	RELEASED FOR ASM	SYM	E C NO	RATE	VERSION OR REV	SHEET NO	LIST NO
AUTOMATED NET SECT.A						PRESENT		248041	- -		30	0557152
07-19-60	SLG	7102	01	A	2	PREVIOUS		247911		SUB0001		0557152

					SIGNAL								TWISTED PAIR OR COAX								ENG DATA
					FROM		ROUT			TO			FROM				TO				
SHEET	WIRE TYPE	NET NUMBER	WIRE NO IN NET	TOTAL WIRE LENGTH	PIN LOCATION	TERMINATOR VIA PIN LOCATION	VIA PIN LOCATION	VIA PIN LOCATION	TERMINATOR VIA PIN LOCATION	LEVEL	PIN LOCATION	SIGNAL LENGTH	REFERENCE LENGTH	REFERENCE LEVEL	REF PIN LOCATION	SIGNAL LENGTH	REFERENCE LENGTH	REFERENCE LEVEL	REF PIN LOCATION		
A	V	001540		6 4	G14D		H14A			1	H13D										
H	T	001541		14 9	0140		H14C			1	H13F		2 3		014J		2 0		H13J		
A	V	001543		4 3	H13E					1	H14H										
A	V	001544		3 7	J15E					2	J15G										
A	V	001544		3 9	J15B					1	J15E										
A	V	001544		5 3	H14E		H14K			1	H16H										
A	V	001544		5 6	H16H		J16=			2	J15B										
A	V	001544		6 3	J15G					1	K15G										
A	V	001546		4 6	J15A			J16C		1	J16F										
A	V	001548		6 0	J15F			J16G		1	K16B										
A	V	001550		7 5	J15D			J16E		1	K16M										
A	V	001551		3 7	B19A					1	B19B										
H	T	001551		6 6	K15F			K19N		1	T19B		2 0		K15J		1 7		T19A	0	T T
H	T	001551		27 9	819A		K18D	K16J		2	K15F		2 0		819*		2 4		K14J	1	T
H	T	001559		6 6	A15K			B19-		1	B19D		1 7		A15J		2 3		B19J	1	F T
A	V	001561		10 6	F22B		H23-	H26C		1	H26F										
A	V	001561		15 4	F22B		F22-			1	G02M										
A	V	001563		6 9	G23K		G24D	H27A		1	H27F										
A	V	001563		18 1	G23K		F23E			1											

Figure 13 - Net List Contains Panel Wires in Order of Reference Net Number.

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SMS CHASSIS WIRE LIST

TYPE OF LIST	TYPE OF CHASSIS	MACHINE TYPE	FRAME	GATE OR MODULE	CHASSIS	RELEASED FOR ASM	DTR	E C NO	DATE	VERSION NO DFI	SHEET NO.	LIST NO
AUTOMATED CHECK SECT.B	SLO	7102	02	A	2	PRESENT		248041	- -		83	0557169
07-20-60						PREVIOUS		247911				0557169

					SIGNAL								TWISTED PAIR OR COAX								ENG DATA					
					FROM			TO					FROM				TO									
	WIRE TYPE	NET NUMBER	WIRE NO IN NET	TOTAL WIRE LENGTH	PIN LOCATION	TERMINATION AREA PIN LOCATION	VIA PIN LOCATION	VIA PIN LOCATION	TERMINATION VIA PIN LOCATION	LEVEL	PIN LOCATION	SIGNAL LENGTH	REFERENCE LENGTH	REFERENCE LEVEL	REF PIN LOCATION	SIGNAL LENGTH	REFERENCE LENGTH	REFERENCE LEVEL	REF PIN LOCATION						
H	T	006628		11 9	J28G					1	F28F		7 4		G26J		4 4		E27J	V					
A	V	007386		6 7	J28H			J23R		1	J23M									V					
A	V	007386		6 9	J28H		H28L			2	H26F									V					
A	V	007314		4 5	J28K					1	J26P									V					
A	V	006447		3 7	J28L					1	J28M														
A	V	007308		4 0	J28M					2	J28R														
A	V	006447		3 7	J28M					1	J28L									V					
A	V	006447		4 0	J28N					1	J27L									V					
A	V	007396		5 6	J28P		J28G			1	J26C									V					
H	7	007396		8 4	J28P		J28C	H24R		2	H24G		2 3		J28J		1 7		H24J	V					
H	7	005597		29 3	J28Q		H27R	F02M		2	C02C		5 6		H26J		7 6		A04C	V					
A	V	007308		4 1	J28R					1	J27N									V					
A	V	007308		4 0	J28R					1	J28M									V					
H	7	010217		9 0	K01B					1	711B		1 7		K01A		1 7		711A						
H	7	010205		7 5	K01C			K06N		1	706B		1 7		K01A		1 7		706A						
H	7	014296		20 0	K01P		J02A				723B		1				1 7								
H	T			28 6																					

Figure 14 - Check List is Sorted in "from pin" Sequence and Contains all Wires in their Normal and Inverted Order. Logical Inconsistencies are Detected and Summarized.

INTER CHASSIS MASTER LIST MACH 7101T MFI PREV E C 700021

LOC. 15A PART NUMBER 0545576 E C 700015 RUN PAGE 1

LENGTH	NET	PAN PIN	PAN PIN	SHD	SHD	WT
33 6/8	2620	1 B09E	2 J08C	1 B09J	2 J08J	C
21 3/8	2835	1 B23C	2 H02D	1 B23J	2 H02J	C
		1 B24E	2 J12D	1 B24J	2 J12J	C
24 2/8	2606	1 B27F	2 H12F	1 C20J	2 G06J	C
19 5/8	2909	1 C20C	2 G06F	1 B27J	2 H12J	C
11 5/8	2904	1 C20F	2 B07E	1 C20J	2 B07J	C
16 2/8	1943	1 C26E	2 D22G	1 C26J	2 D22J	C
24 4/8	2675	1 C27E	2 J13C	1 C27J	2 J13J	C
		1 D01B	2 G25E	1 D01J	2 G25J	C
15 4/8	2805	1 D05N	2 D03C	1 D05J	2 D03J	C
24	759	1 D06N		1 D06J	2	C

Figure 15 - Interpanel Jumper List Consists of Wires that Connect Directly from one Panel to another on the same Gate without Passing through the usual Edge Connectors.

HOW TO IMPLEMENT DESIGN AUTOMATION

Development groups using the facilities of design automation should be familiar with organizational procedures and computer programs. The effective use of this system will directly reflect in the records maintenance, the manpower requirements, and the scheduling of a machine from the concept to release. The following points are offered as a guide for the effective implementation of design automation.

1. Contact liaison group, Dept. 246, for the assignment of personnel for technical assistance.

2. Instruct all engineers and designers on the input requirements. (This service available from Dept. 246.)

   a. Logic grid sheets

   b. Checking program - forms

   c. Back panel wiring program - forms

3. Request manuals and all written information about design automation.

4. Assign personnel to coordinate with design automation about all pertinent problems regarding the records.

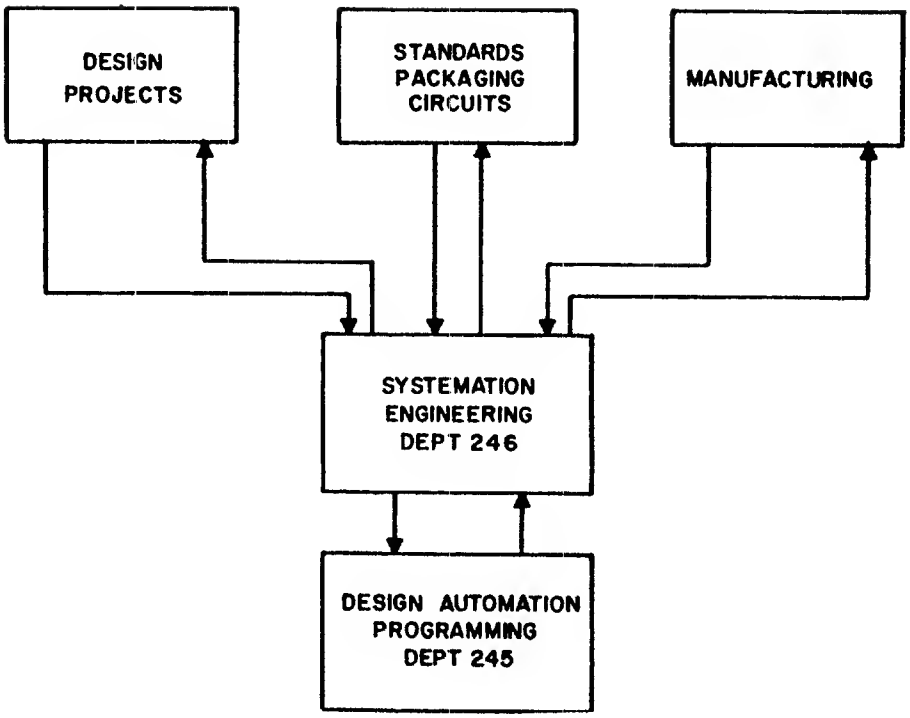
5. Coordinate new circuit information to insure compatibility and installation in the design automation programs.

6. Resolve all packaging problems to insure compatibility with the present and future programs.

7. Inform Dept. 246 about schedules of workloads.

8. Contact Dept. 240 for assistance in budgeting the use of design automation.

The Importance of Liaison cannot be stressed too much. Initial contact with design automation should be made through Dept. 246, Systemation Engineering. Design automation, on the other hand, is concerned with general subjects in three areas: design, standards, and manufacturing. A breakdown of subjects according to area is as follows:



Liaison to Design Projects

A. Education

B. Procedure modifications

C. Program modifications

D. Circuit logical block descriptions

Liaison to Standards

A. Circuit logical block description

B. Program modifications due to package changes

Manufacturing

A. Format of outputs

B. Input criteria for automated assembly machines

Proper Scheduling of the Workload should be taken into consideration if bottlenecks are to be avoided. Managers of systems that comprise hundreds of system pages should be mindful of the delays that can arise if an excessive number of pages are submitted at one time. The initial transformation of the basic system page into machine language is the most time-consuming operation; therefore, pages should be submitted in groups of about thirty in chronological order of completion.

A second operation in which prior planning is important is the correcting of errors resulting from the checking programs. Large machines require three or four correction re-cycles before the system's pages are in order. Delays of one day or more during correcting periods eventually lead to three or four weeks before the systems are ready to extract panel wiring. This re-cycle time can be shortened by:

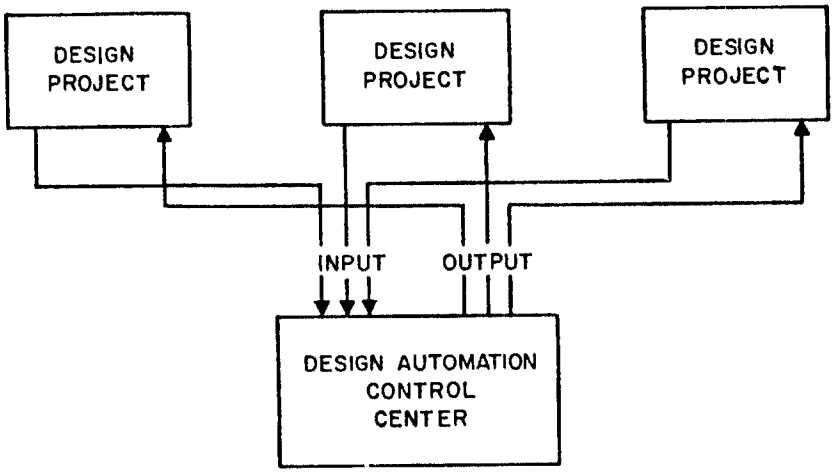
1. Forming teams of two or three men each to correct the errors.

2. Thoroughly examining each error code.

3. Have engineering assistance available when technical problems arise.

4. Accurately making corrections to the systems to eliminate any reoccurrence.

Understanding Work Flow can be an aid to those who maintain liaison with design automation. Representatives from design projects should submit all



production inputs to the control center, which is responsible for the scheduling of work through all of the stages of the program. Outputs, as well,

are controlled from the center, which also processes inquiries regarding the status of any job.

Facilities available at the computational laboratory, in addition to the control center, include:

System Page Control Section where the production inputs to Stage 1 are set up.

Keypunch Section where logic sketch sheets and changed system pages are keypunched into machine language.

System Page Edit Section where output pages are edited for accuracy.

Checking Control Section where the production inputs to Stage 2 are set up.

Panel Wire Control Section where the production inputs to Stage 3 are set up.

700 Series Computer Section where two 705 computers and one 704 computer are employed.

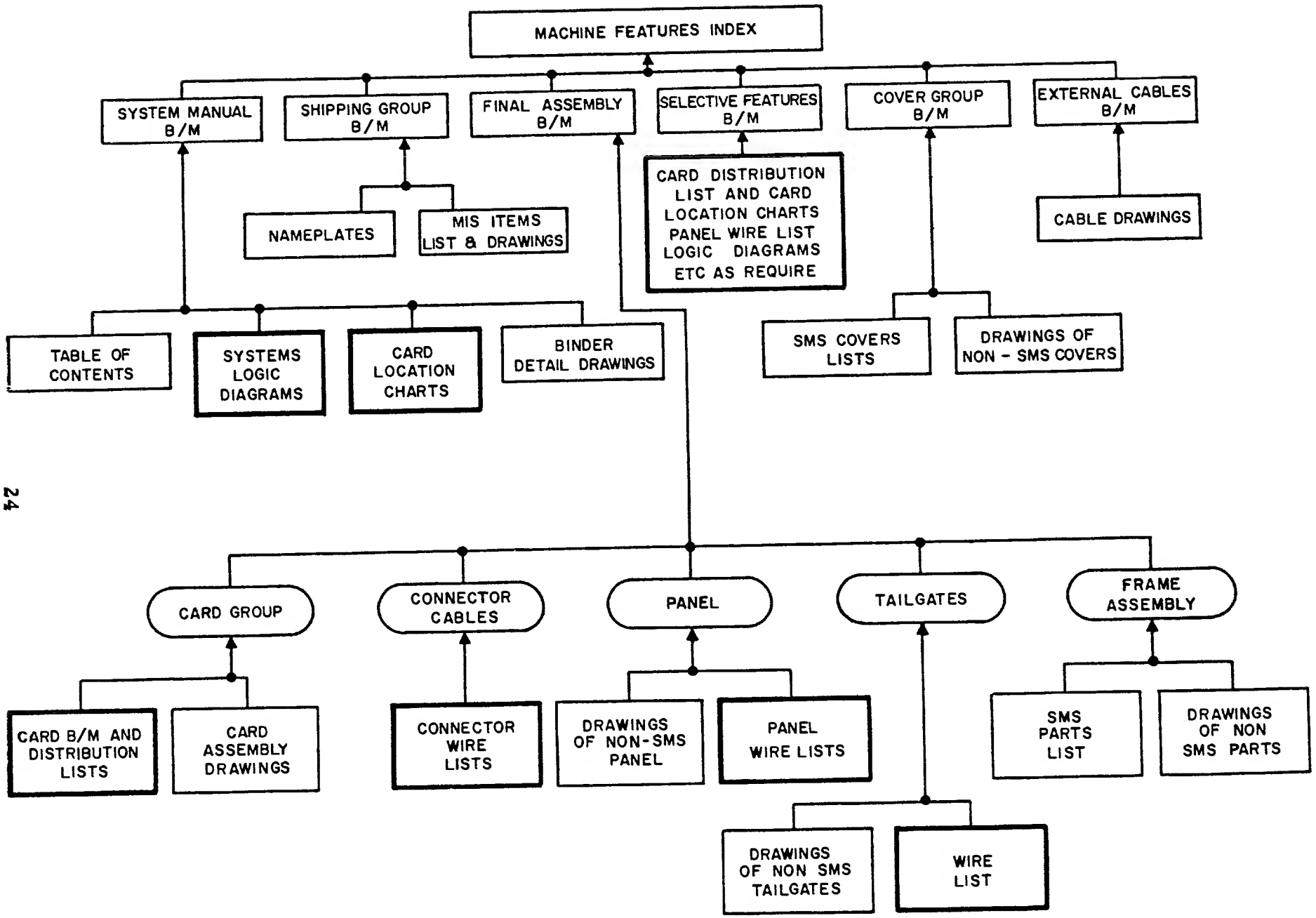
Tape Library where system logic pages and panel wire lists are retained on magnetic tape.

700 Series Program Release Office to control production programs.

Accounting Machine Section where miscellaneous card outputs from design automation programs are formalized.

To Release a Machine, the design groups furnish the Engineering Records Department with documents describing the machine. From these documents the Engineering Records group will compile the bills of material and the machines features index. The chart shows what these documents are, and in heavy lined squares which documents can at present be generated by design automation.

In addition, computer programs are used to maintain the bill of materials (Parts Usage Maintenance Programs or PUMP) and to maintain the table of content of system manuals (Change Control System Programs).



Documents Required for the Release of a Machine
(Heavy-lined Blocks Indicate those Documents by Design Automation)

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